Using Metacognitive Writing Strategies to Improve Scientific Article Writing Skills

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Introduction

Writing ability presented in academic discourse is an understanding of hegemony(Kiriakos & Tienari, 2018)as a reasonable and predictable action aimed towards publishing in the chosen journal. However, many academics struggle with writing. However, the academic discourse of hegemony is described as an uncomplicated intellectual and instrumental activity(Kiriakos & Tienari, 2018).

Even though students have received writing material, there are still many who find it difficult to write. This is because the ability to write is a cognitive process(Graham et al., 2018; Mayer & Alexander, 2016)in learners, so they must be able to combine ideas in a writing effectively. In addition, the ability to write is also a complex ability so that students find it difficult to learn(Alfino et al., 2019). Researchers say that writing ability is an important ability and must be mastered by students at the college level(Al Badi, 2015);this is because in writing, a student must be able to organize a sentence into paragraphs and paragraphs into discourse units with the expression of their ideas. Thus, it can be understood that academic ability is a complex process because it involves various aspects both in cognitive and metacognitive learners(Alamri, 2018).

Writing activity is one of the subdomains in language learning. One approach to academic writing is to apply metacognitive theory, where a learner must be able to self-regulate to understand how he can write well. This is important because in writing scientific articles, a student must be able to involve the interaction between himself as a writer and a reader(Hyland, 2004; Paltridge, 2014). In learning to write scientific articles, a student must pay attention to their psychological and cognitive processes(Gregg & Steinberg, 2016). This is because writing scientific articles must include and get to know academic discourse and then build knowledge in the academic genre (Han & Hiver, 2018).

Metacognition is an ability to reflect on one's knowledge and control thinking(Flavell, 1979), by supporting the learner in understanding the relevant aspects of the task. Learners who use metacognitive strategies in learning will have more knowledge about cognitive processes. They can manage, direct, regulate, and guide learning independently(Aziz, 2019). According toBs & Davalos (2016),the result of metacognition is critical reflection in the learning process. This reflection allows the learner to make a change in learning.

According to the findings of studies on the influence of language learning methodologies on abilities, attitudes, and academic accomplishmentexplain that metacognitive, social and memory learning strategies have an influence on learning attitudes, and metacognitive strategies have a positive impact on student achievement(Habók & Magyar, 2018). Another study explains that metacognitive learning strategies are a significant predictor of achievement in improving learning achievement(Callan et al., 2016).

Research on metacognitive exploration with its relationship to writing ability has been carried out byTeng (2019b). Having researched the significance of metacognitive knowledge and regulation in the academic writing

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achievement of university students, Teng came to the conclusion that metacognition is a crucial part of learning, and that students may enhance writing abilities by employing metacognitive tactics.The findings of this study are consistent with the findings of Alamri (2018), which explains that the use of metacognitive strategies has a significant relation with students' writing skills, implying that metacognitive strategies contribute positively to students' writing comprehension. Metacognitive learning practices, in addition to improving students' writing abilities, can raise students' awareness of self-monitoring while learning (Alamri, 2018).

Metacognition is a learner's knowledge of cognitive processes related to the learner's self(Flavell, 1979). Learners can build and transfer information and understanding through a range of areas, circumstances, and activities if they have metacognitive skills. This allows them to be more flexible in their learning(Ambrose et al., 2010; Bransford et al., 2000; Zimmerman & Schunk, 2011). Knowledge transfer is sometimes related to external interpersonal and information distribution. In this study, knowledge transfer refers to the deepening of the material perceived as a cognitive process.Bower (2003)in his dissertation explains that metacognition can encourage students' understanding in cognitive and linguistic processes. To improve students' metacognitive abilities, Tanner (2012)suggests building students' abilities in a structured manner so that they can ask questions related to students' plans to write, monitor and evaluate writing assignments.

Metacognitive awareness is one of the metacognitive aspects that has a reciprocal relationship between self-regulation and the development of individual learners in writing.(Santelmann et al., 2018; Teng, 2019a). Declarative knowledge (awareness strategies), procedural knowledge (awareness of how to use strategies), and conditional knowledge (awareness of when to use strategies) are the three domains of metacognitive awareness(Schraw, 1998; Schraw & Moshman, 1995). Thus, metacognition in writing also leads to the metacognitive domain in certain contexts.

Individual learners' growth in writing is directly linked to their ability to self-regulate and to their metacognitive awareness(Santelmann et al., 2018; Teng, 2019a).. In addition to (Santelmann et al., 2018; Teng, 2019a). Metacognitive awareness is divided into three parts: declarative knowledge (awareness of strategies), procedural knowledge (knowledge of how to apply strategies), and conditional knowledge (knowledge of when to employ strategies) (Schraw, 1998; Schraw & Moshman, 1995). When writing in some settings, the metacognitive domain can also be reached through metacognition.

Additionally, it can be said that "writing is applied metacognition," since thinking is interwoven into every element of the writing process(Hacker, Dunlosky, et al., 2009; Hacker, Keener, et al., 2009). The application of metacognitive strategies in learning to write allows students to understand and express them in making decisions during the writing process(Cohn & Stewart, 2016). In addition, metacognition can also help students to use appropriate strategies in developing writing skills(Negretti, 2012). So that the application of metacognitive learning strategies in academic writing courses can encourage students' abilities to transfer knowledge about the dafting, rewriting, and editing processes to various writing contexts(Pacello, 2014).

Metacognitive reflection in Pacello's (2014) research allows students to recognize writing as a conscious method of how they send letters, to whom they write, and how the public receives messages. Thus, the authors underlined that pedagogical methods emphasizing a metacognitive strategy approach to reading and writing in higher education can help learners to meet literacy needs in different academic, professional and personal contexts. Meanwhile, according toTarricone (2011), refleksi metakognitif menghubungkan persepsi metacognitive reflection connects the perception of students' metacognitive abilities with writing practice. So that reflection is equally important for the development of learners in the writing process(Dewey, 1939). Thus it can be understood that when students reflect, they take the time to focus on cognitive aspects that lead to certain actions by informing future activities, because the process of reflection is a complex process in which feelings and cognitions are closely tied(Boud et al., 2013). This research is focused on knowing the effect of metacognitive strategies in improving the ability to write scientific articles in the context of university-level students in Indonesia. Several studies conducted in various nations have found that the application of metacognitive methods in academic writing produces beneficial results. Differences with previous research, this study focuses on one of the metacognitive strategies adopted fromOxford (1994); In addition, this research also focuses on how students can become independent learners when writing scientific articles..

Methods

Research design

This study compares two separate groups using a quasi-experiment. The experimental group got information on writing scientific articles using metacognitive methods, while the control group received material on writing scientific articles with the tactics that had previously been taught. Pre- and post-tests were given to both the

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experimental and control groups, but only the experimental group got extra treatment by learning metacognitive methods. The duration between the pre-test and the post-test was eight weeks. Using the same test pattern, the experimental group will figure out a better technique for producing an article.

Research subject

To carry out this research, there were 60 college-level students where the research location used a homogeneous class model, namely classes for boys and girls, so the researchers also divided the experimental and control groups according to the division determined by the Department. Thus there are 30 students in the experimental group and 30 students in the control group. From the results of the initial test, students with low scores (60 and below) were assigned to the experimental group and students who had high scores were assigned to the control group.

Research instrument

The researcher used two research instruments, the first was a pre-test using "the Michigan Writing Assessment Scoring Guide"(Hamp-Lyons, 1990). This rubric analysis is used to assess students' writing composition using three aspects of assessment (writing concepts and argumentation, rhetorical characteristics, and language management). Furthermore, the researchers conducted an intervention and special treatment for 8 weeks for the experimental group, after that the researchers conducted a post-test to determine changes in the students. The second instrument is the Metacognitive Strategy Questionnaire (MSQ). MSQ is given to find out the strategies used by students when Planning, Monitoring, Evaluating.

Data collection technique

The first component of the data collection process was a pre-test and post-test on the technique of writing scientific articles before and after they used metacognitive strategies, then the researchers compared the results of the pre-test and post-test. Next, the researcher gave a questionnaire about metacognitive strategy at the end of the eighth meeting. This questionnaire is only used to determine the strategy of writing articles, where students are asked to show their writing methods during planning, monitoring and evaluating. This questionnaire is confidential so that students can only write their test numbers, besides that students complete this questionnaire without discussing it with their friends. This questionnaire is written in Indonesian so that it is easier for students to understand and answer questions.

Data analysis technique

All instruments were analyzed according to the research questions, to find out whether there was a significant difference between the students' scores from the pre-test and post-test for both the control and experimental groups using the paired-simple t-test. The researcher made the control group as a comparison for the experimental group who received special treatment (learning using metacognitive strategies).

For the "Metacognitive Writing Strategy, the Metacognitive Strategy Questionnaire (MSQ)" was analyzed using the Scale Scores for Language Learning (SIL) version 5.1 by Lin & Zhang (2011) and Oxford (1990) which shows usage levels for the 16 sub-categories of Metacognitive Writing Strategy.The frequency scale of the strategy used is based on SILL (Oxford, 1990) and its interpretation is shown in the following table.

Table 1. Frequency Scale of Strategy Use

Mean Score	Frequency	Evaluation
4,5–5,0	High	Always or almost always used
3,5–4,49		Usually Used
2,5–3,49	Medium	Sometimes used
1,5–2,49		Generally not used
1,0–149	Low	Never or almost never used

Results and Discussion

This research was carried out well for 8 weeks or for two months, starting from March 2021 - April 2021. This study took the pretest score as a reference for group determination. Students who get a pretest score below the average or below the minimum completeness standard will be included in the experimental group; while students who get a pretest score above the minimum standard of completeness will be included in the control group. The experimental group received different treatment during this study, where the experimental group received special treatment (learning using metacognitive strategies).

The data from the pretest and posttest were analyzed first with a normality test to prove that the data obtained were normally distributed. The results of the normality test of the data obtained showed that both the pretest and posttest results of the two groups were normally distributed (table 2).

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Table 2. Normality test results of the pretest-posttest results of the experimental group and the control group

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Experiment Group Pre-test	.126	30	.200*	.932	30	.055
Experimental Group Post-test	.114	30	.200*	.957	30	.257
Control Group Pre-test	.096	30	.200*	.965	30	.420
Control Group Post-test	.156	30	.060	.934	30	.064

*. This is a lower bound of the true significance.
a. Lilliefors Significance Correction

After knowing all the data from the pretest and posttest results from the two groups were normally distributed; then proceed to the next analysis stage, namely the paired-simple t-test to test the significance of the posttest results on the pretest results both in the experimental group and in the control group. The results of the paired-simple t-test from the two groups can be seen in the table below.

Table 3. Average Pretest Result Score and Posttest Result Score

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Experiment Group Pre-test	50.13	30	6.219	1.135
	Experimental Group Post-test	78.70	30	7.135	1.303
Pair 2	Control GroupPre-test	65.73	30	2.504	.457
	Control Group Post-test	78.23	30	5.469	.998

Table4. Results ofpaired-simple t-test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Experiment Group Pre-test Experimental Group Post-test	-28.567	9.975	1.821	-32.291	-24.842	-15.686	29	.000
Pair 2	Control GroupPre-test Control Group Post-test	-12.500	6.421	1.172	-14.897	-10.103	-10.663	29	.000

The probability value (p) is labeled Sig. (2-tailed) in the Paired Samples Test table above (table 4), and it is 0.000 for Pair 1 (pretest-posttest experimental group) and 0.000 for Pair 2 (pretest-posttest control group). If this probability value is less than 0.05, there is a significant difference between the two scores. The probability value is 0.000 for both groups (the experimental group and the control group.) It is adjusted to three decimal places. This means that the real probability are less than 0,005. This figure (0,005) is less than the alpha value of 0,05 that was requested. As a consequence, it is possible to conclude that there is a significant difference between the pretest and posttest in the experimental and control groups. The df (degrees of freedom) estimated as a sum of N-1 is also shown in the table above (similar to Correlation). Hence, in this case, df is 29. (i.e. 30-1).

When looking at the average score of both partners, it is necessary to ignore the negative sign because it is dependent on the average score of one being deducted from the other. The number is negative because the mean score from the posttest is deducted from the mean score from the pretest.

Results given above reveal that there is a statistical difference between the treated and untreated groups in mean scores. The eta-squared test was employed to determine the statistical significance of the intervention effect.The results shown above demonstrate that there is a statistically significant difference in mean scores between

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the treated and untreated groups. The eta-squared test was used to examine if the intervention had a statistically significant influence on the outcome.

Questionnaire Data from the Results of Writing Scientific Articles for the Experimental Group

The questionnaire consists of 40 items, each of which has a number to pick from as a scale for describing it. Oxford (1990) used the mean usage of metacognitive techniques based on SILL scale scores to calculate the percentage of students who used each of the 16 Metacognitive Writing Strategies subcategories.

According to the mean scores reported by students themselves for the 16 subcategories of metacognitive writing strategies, it was possible to demonstrate the contribution of metacognitive strategies to students' writing comprehension performance in the present study. Table 6 shows the mean scores for the subcategories as well as the frequency with which they are used.

Table 5. Metacognitive Writing Strategies Used by Students in Writing Scientific Articles

Planning (Pre-Writing)	**Mean**	**Level**	**Monitoring (While writing)**	**Mean**	**Level**	**Evaluating (Post-Writing)**	**Mean**	**Level**
1. Knowledge of the specific writing assignment, its obstacles, and the abilities required to do it	3.2	M	1. Transformation of writing	3.1	M	1. Summarizing/ paraphrasing	2.8	M
2. Recognizing the work at hand	3.5	H	2. Knowledge of facts and proper grammar required for written communication	3.5	H	2. Awareness of the necessity of revision	3.2	M
3. Identifying the aim and determining the need for a particular plan.	3.4	M	3. Using the writing format effectively	3.4	M	3. Checking the effectiveness of the approached solution	3.1	M
			4. Reflecting on the writing task	3.4	M	4. Revision at the most fundamental level in order to improve the quality of the writing	3.0	M
			5. Self-monitoring of progress	3.3	M	5. Evaluating the quality of writing	3.1	M
			6. Organization of facts	3.2	M	6. The act of gathering additional data.	3.3	M
			7. Taking a second look at the work in progress	3.3	M			
Total Mean	**3.4**	**M**		**3.3**	**M**		**3.1**	**M**
	3.25 (M)							

Students' metacognitive writing methods are represented in the table above by the average scores of each of the 16 subcategories. Each student's metacognitive writing strategy score varied from 2.8 to 3.5 (overall mean = 3.25). This suggests that students in the experimental group employ all three parts of metacognitive writing strategy equally while writing scientific articles (i.e. when planning, monitoring, and evaluating). The highest use of strategies is Awareness of the given task (Planning) and Awareness of facts and grammar needed to write (Monitoring); while the least used is Summarizing/paraphrasing (Evaluating). These findings address the issue of which metacognitive methods students in the experimental class employ the most.

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Discussion

The Relationship between Implementation of Metacognitive Strategies and Learning to Write Scientific Articles

Based on the results of pretest to posttest, both groups experienced an increase in score. The mean score of the control group increased from 65.73 to 78.23 (12.50 points) while the experimental group increased from 50.13 to 78.70 (28.57 points). The increase in score in the control group is considered less significant because the increase in points is quite small (12.50) and is still below 15 points. In the other side, the average score of the experimental group increased significantly with an increase of 28.57 points. This result proves that when metacognitive strategy instruction is applied to the activity of learning to write scientific papers, students show better performance and understanding in doing their writing assignments. This is evidenced by their posttest scores which are better than their pretests. This is in line with what has been researched byAripin & Rahmat (2021). Aripin and Rahmat (2020) studied metacognitive writing methods. This study aimed to compare male and female students' metacognitive processes when writing scientific articles. As a consequence, both male and female students who received metacognitive strategy training had seen a rise in post-test results.

According to the findings of this study, the pretest to posttest score rise for the control group was not statistically significant. The experimental group, on the other hand, had a considerable rise in their pre- and post-test scores of over 30 points. Writing scientific publications is significantly associated with using metacognitive methods, as evidenced by this study.

These findings imply that the treatment differences between the control and experimental groups did have an effect on the students' scores on scientific writing. These findings corroborate prior study done by Qin & Zhang (2019). They examined the metacognitive writing styles employed by students in the English Department when writing scientific articles. The study found that students who employed more metacognitive methods performed better on a test of scientific article writing. The experimental group got treatment using metacognitive writing skills, which they applied during the posttest. They outperformed the control group that did not use the metacognitive writing method on the posttest. It is likely that some students in the control group used metacognitive methods that were already ingrained in their thoughts, since certain metacognitive tactics were innate in some individuals. However, the control group possessed fewer metacognitive strategies than the experimental group, as the control group did not get metacognitive strategy training. Hence, as mentioned by Qin & Zhang (2019) that "students who employ more metacognitive techniques do better on reading comprehension exams, while students who employ less metacognitive methods perform lower."

The study also found that treatment using a metacognitive technique had a significant impact size. It is widely accepted that the eta-squared value of 0.48 indicates a significant impact. Students in the experimental group outperformed those in the control group by a wide margin. This finding is also in line with that of Qin & Zhang (2019), who discovered a significant relationship between the use of metacognitive methods and students' English writing proficiency. Students' writing abilities in English have been boosted by metacognitive writing strategy training.

Those pupils who had received metacognitive techniques training performed significantly better than their peers who had not received it. According to a considerable improvement in student writing scores, metacognitive methods have a good impact on student writing output. Student writing comprehension can be improved by strengthening metacognitive methods, which have been found to play an essential part in students' learning. There are 16 subcategories of metacognitive reading strategies used by students. For this, we refer to the research resultsKodituwakku (2013)who previously also researched metacognitive writing strategies. Students' writing skills improved when the metacognitive technique teaching was used to assist them write scientific papers. The more students use metacognitive tactics, the more likely they are to develop their writing abilities and score higher on writing assignments and assessments.

Students that use metacognitive methods have specific writing objectives and are aware of how to accomplish them (Qin & Zhang, 2019). They can optimize their ability to plan which writing approach to apply, accurately pick the most appropriate one, and conduct self-assessment and self-evaluation in order to attain optimal writing performance. As a consequence, pupils who possess metacognitive methods are capable of writing effectively and efficiently.

Conclusion

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This study focuses on the success of learning to write scientific papers as seen from the student's grades. According to this study, metacognitive writing practices have an effect on students' writing outputs It encourages pupils to improve their writing abilities and to do it in an efficient manner. As a result of applying metacognitive methods in their writing tasks, pupils will become better and more strategic writers. Reading may be planned, monitored and evaluated automatically by strategic writers who use the three phases of metacognitive strategy. So they get the most out of what they've read in order to obtain their goal result.

Despite the fact that this study has demonstrated that metacognitive techniques have a beneficial impact on learners' writing ability and, as a consequence, have an impact on their writing accomplishment, it is important to evaluate other aspects that may influence students' writing ability.

Metacognitive approaches tend to enhance students' writing skills, according to the findings of this study. Metacognitive techniques, then, need to be given more consideration when it comes to scientific writing. There are a number of ways that teachers might begin to teach metacognitive skills to their students so that they are better prepared to apply them in the classroom and beyond. Yet students can also learn about metacognitive methods and then put them into practice in order to achieve certain objectives. Every learning activity is affected by a variety of elements, some of which students were not even aware of. Students' psychological characteristics, such as their beliefs, motives, and self-esteem, should be taken into account while developing metacognitive practices in order to predict and overcome potential issues.

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